Eur J Vasc Endovasc Surg (2015) 49, 154–155

INVITED COMMENTARY

Commentary on 'Three-dimensional CT Reconstruction of the Carotid Artery: Identifying the High Bifurcation'

N. Chakfé [a,*], **M. Ohana** [b], **Y. Georg** [a]

[a] Department of Vascular Surgery and Kidney Transplantation, University Hospital of Strasbourg, Strasbourg, France
[b] Department of Radiology, University Hospital of Strasbourg, Strasbourg, France

In their paper, McNamara et al.[1] describe an original computed tomography angiogram (CTA) based method for characterizing the level of the carotid bifurcation. As stated in their introduction, even though this well known anatomical variant is recognized as being associated with an increased operative risk, a standardized definition of "high-level bifurcation" is still lacking, as there are indeed different potential approaches for defining it. One can classify the level of the carotid bifurcation by using a purely statistical definition, such as the shortest quartile in a normal distribution as used in this study, or a clinical definition, the level that makes the intervention more challenging for the vascular surgeon and at a higher risk of complication for the patient.

The authors opted for the first option, introducing a novel CTA based metric, the straight line distance measured from the base of the skull down to the bifurcation. By comparing the obtained results to notable bony landmarks, they suggested that a bifurcation less than 5 cm under the level of the mastoid, as measured on a lateral three dimensional (3D) view, is a good marker of a "high level bifurcation" (sensitivity, 82.9%; specificity, 80.1%). The strength of the study lies in its use of CTA over human cadavers, offering an actual overview of the *in vivo* anatomy, its high reproducibility with an excellent inter-reader agreement of the proposed measure method, and its potential applicability in daily routine, as a single sizing on a lateral 3D view can be easily and quickly obtained.

However, these interesting results are hindered by some limitations. As discussed by the authors, no correlation is made with the surgical outcome of the bifurcations classified as high. Further studies are necessary to know if "high level bifurcations", as defined in this paper, are effectively at a higher surgical risk and if the proposed threshold of 5 cm is capable of distinguishing patients with a significantly increased operative risk, therefore helping the vascular surgeon in the pre-operative planning and in predicting potential difficulties. Owing to its retrospective design with inclusion of patients randomly chosen from a local database, and not from specific patients where an endarterectomy was planned, this study cannot answer this crucial question.

Moreover, it would have been interesting to compare these quantitative metrics with the subjective evaluation made by the vascular surgeon based on the CTA data. Indeed, all current CT software has the ability to render highly detailed 3D images using a volume rendering (VR) technique,[2] with the possibility of merging blood vessel VR and bone VR using a transparency setting for bone, giving a nice overview of the arteries with the overlaid bony landmarks (Fig. 1). With direct control of the 3D volume, the

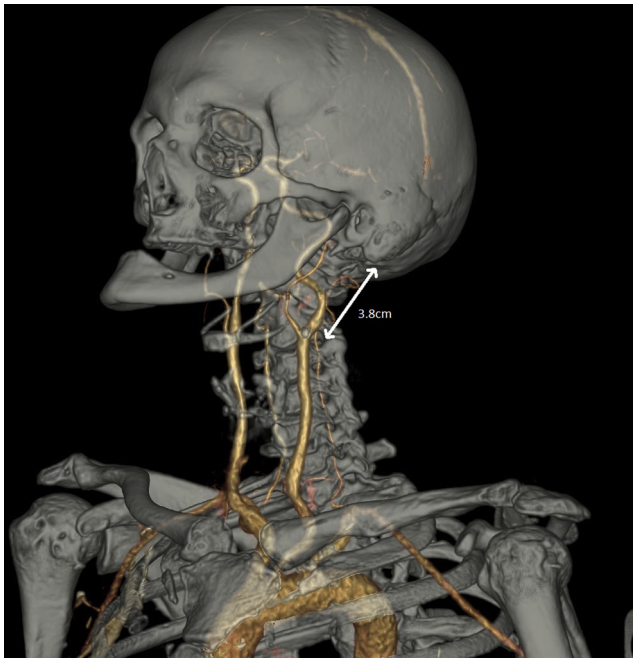

Figure 1. Sixty seven year old patient with severe proximal right internal carotid artery stenosis (NASCET 80%). Three dimensional volume rendering reconstruction of the pre-operative supra-aortic trunks computed tomography angiogram demonstrated a high right carotid bifurcation, located 3.8 cm under the level of the mastoid. However, due to the particular configuration of the mandible clearly documented on this image, this patient was not considered as having a higher operative risk.

DOI of original article: http://dx.doi.org/10.1016/j.ejvs.2014.10.006
* Corresponding author. N. Chakfé, Department of Vascular Surgery and Kidney Transplantation, Les Hôpitaux Universitaires de Strasbourg, B.P. 426, 67091 Strasbourg Cedex, France.
E-mail address: nabil.chakfe@chru-strasbourg.fr (N. Chakfé).

http://dx.doi.org/10.1016/j.ejvs.2014.11.009

surgeon can precisely evaluate the location of the carotid artery bifurcation and its relationship to the adjacent anatomical structures, and determine if the patient's anatomy is favourable or at risk, and consequently adapt the treatment.

Finally, these data could also be compared with a duplex scan performed per-operatively, immediately before skin incision to confirm the actual level of the bifurcation, in order to anticipate surgical difficulties and to optimize the placement of the cervical incision.[3]

The final therapeutic decision is based on the subjective assessment by the surgeon of both clinical and imaging examinations, a subtle exercise in which experience and clinical judgment are crucial. Will the introduction of an objective metric, as proposed by the authors, really help the surgeon in discriminating the high risk patient, or will it be found to be not efficient enough? Only a prospective study of patients planned for an internal carotid endarterectomy would be able to answer this question. Meanwhile, detailed clinical examination and precise CTA review remain the *de facto* standard of carotid bifurcation analysis.

REFERENCES

1 McNamara JR, Fulton GJ, Manning BJ. Three-dimensional CT reconstruction of the carotid artery: identifying the high bifurcation. *Eur J Vasc Endovasc Surg* 2014.

2 Fishman EK, Ney DR, Heath DG, Corl FM, Horton KM, Johnson PT. Volume rendering versus maximum intensity projection in CT angiography: what works best, when, and why. *Radiographics* 2006;**26**:905—22.

3 Ascher E, Hingorani A, Marks N, Schutzer RW, Mutyala M, Nahata S, et al. Mini skin incision for carotid endarterectomy (CEA): a new and safe alternative to the standard approach. *J Vasc Surg* 2005;**42**:1089—93.